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NAVY FLEET MATERIAL SUPPORT OFFICE MECHANICSBURG PA 0--ETC F/G 15/5
UNAUTHORIZED LONG SUPPLY STUDY, (U)
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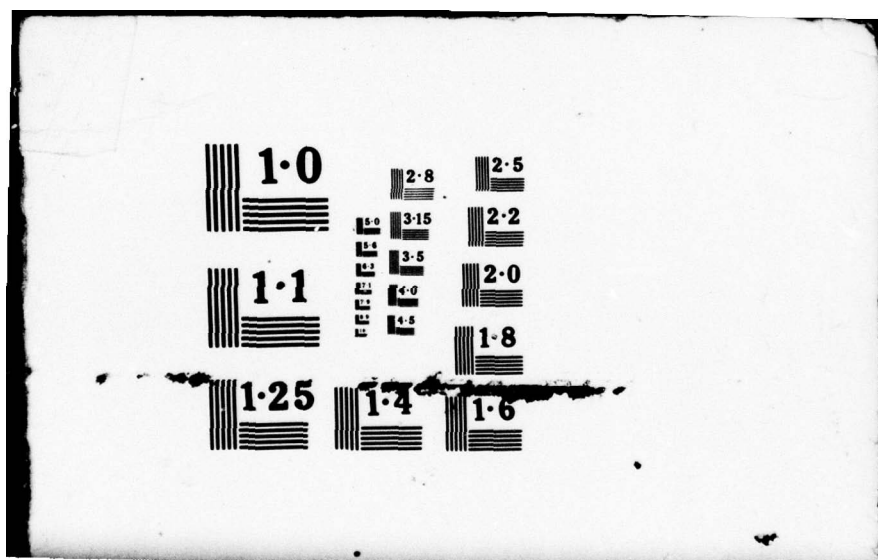
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6 UNAUTHORIZED LONG SUPPLY STUDY

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REPORT 137

PROJECT NO.
F9241-E22-7305

11 28 Mar 79

Submitted:

L. J. Burdick
L. J. BURDICK
Operations Research Analyst

12 69 p.

10 L. J. / BURDICK

Approved:

R. E. Lewis
R. E. LEWIS, LCDR, SC, USN
Director, Operations Analysis Division

H. J. Johnson
H. J. JOHNSON, CAPT, SC, USN
Commanding Officer, Navy Fleet
Material Support Office

DATE MAR 28 1979

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ABSTRACT

Tenders are currently required to offload ULS (Unauthorized Long Supply) material at least every 90 days. This study evaluates variations in the timing of offloads, the value of the Economic Retention Level used in computing the ULS quantity, and various parameters used in computing an item's authorized inventory levels. Alternative offload policies were evaluated in terms of the impact on (1) dollar investment in on-hand plus due-in stock; (2) number of items offloaded; (3) dollar value of items offloaded; (4) number of resupply orders and Direct Turnover requisitions; (5) gross requisition effectiveness; (6) gross unit effectiveness; and (7) net total cost. Analyses were conducted for an FBM (Fleet Ballistic Missile) submarine tender and an attack submarine tender. The study identified seven alternative policies which reduced the number of current offloads by over 50% with no decrease in effectiveness and less than 2% growth in inventory dollar value. The most significant factor in these seven alternatives was an adjustment in the Economic Retention Level from the current value of \$10 to \$50 or \$100.

A

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EXECUTIVE SUMMARY

1. Problem: Submarine tenders are regularly monitored to prevent build-up of excess material. On-hand material in excess of the ship's authorized level plus one year of predicted demand is considered excess or long supply material. If the dollar value of the long supply material equals or exceeds the value of the ERL (Economic Retention Level), a parameter currently set at \$10, then the long supply material is considered ULS (Unauthorized Long Supply) and is subject to offloading. Currently offloads of ULS are required at least every 90 days.

Several problems are associated with the current offloading policy of ULS on submarine tenders. These include:

- . Offload actions require many manhours of work by tender and stock point personnel and require much data processing time.
- . During the period of transshipment of the ULS material, asset visibility is lost.
- . Material may be lost in transshipment.
- . Material offloaded may be sent to disposal.
- . Material may be offloaded and required in the near future by the tender.

Relaxation of the offloading policy would result in reductions

In tender and stock point workload, data processing requirements, material losses, material disposal actions and stock replenishments. However, a policy of limited offloading of ULS may generate an unacceptable increase in inventory investment.

2. Objective: The objective of this simulation study was to determine the investment growth to be expected under a limited offloading policy and the change in number of items offloaded, dollar value of items offloaded, number of resupply and Direct Turnover requisitions, gross requisition and unit effectiveness, and net total cost.

3. Approach: Analyses were performed for one AS(FBM) tender, the USS HOLLAND, and one AS(SSN) tender, the USS ORION. Alternative policies were evaluated using a computer simulation program modeling the SUADPS (Shipboard Uniform Automated Data Processing System) 207 Demand Processing and Levels Computation Programs. Allowance and demand data required for the simulation were obtained from actual Master Record Files from each of the test ships.

Alternatives that were evaluated included changing the number of days between offload and changing the value of the ERL. Selected SUADPS parameters that impact on inventory levels were also varied. Specifically, the Demand-Based Item qualification and retention criteria, the Operating Level Multiplier Factor, and the Safety Level Factor were varied. Various combinations of the above changes were also evaluated.

4. Findings: Complete elimination of offloads resulted in a 9%

increase in the inventory dollar value at the end of 31 months for the USS ORION and a 4% increase at the end of 32 months for the USS HOLLAND. Analysis of the growth trends indicates that these percentages would most likely continue to grow over time.

Of the various individual factors evaluated, increasing the ERL had the greatest impact on reducing offloads. Seven alternative policies were identified which reduced the number of offloads by over 50% with no decrease in effectiveness and less than a 2% growth in inventory. These alternatives all increased the ERL value.

It is recommended that the authorized value of the ERL be raised to \$50 or \$100.

1. INTRODUCTION

Submarine tenders are regularly monitored to prevent build-up of excess material. Currently, offloads of excess material are required at least every 90 days. If an item is a DBI (Demand-Based Item), the maximum value of stock authorized (by reference 1 of APPENDIX A) is equal to the sum of the Safety Level and the Operating Level. If an item is not a DBI, the maximum value of stock authorized is based on the tender load list and COSAL (Coordinated Shipboard Allowance List) quantities. This maximum value of stock authorized is called the item's SAL (Ship Authorized Level).

If an item has more material on-hand than the sum of its SAL and one year of predicted demand, the additional material is considered excess or long supply material. If the dollar value of the long supply material is less than the ERL (Economic Retention Level), the long supply material may remain aboard the submarine tender. If the dollar value of the long supply material equals or exceeds the ERL, the long supply material is considered ULS (Unauthorized Long Supply) and should be offloaded from the tender. The rationale behind having an ERL is that it is considered uneconomical to go through the off-load process for items involving only a small value of excess material. Currently, the ERL is \$10.

Several problems are associated with the current offloading policy for ULS on submarine tenders. These include:

- . Offload actions require many manhours of work by tender and stock point personnel and require much data processing time.
- . During the period of transshipment of the ULS material, asset visibility is lost.
- . Unmatched OSO (Other Supply Officer) transfers have developed for material that is lost in transshipment.
- . A portion of the material offloaded may be sent to disposal.
- . Material is frequently offloaded and later required by the tender.

Relaxation of the offloading policy would result in reductions in tender and stock point workload, data processing time, losses of material, material disposal actions, and stock replenishments. However, a policy of limited ULS offloading may generate an increased inventory investment on the tender. This simulation study projects the extent of investment growth to be expected under a reduced offloading policy. Also this study estimates the change in number of items offloaded, dollar value of items offloaded, number of resupply and Direct Turnover requisitions, and effectiveness under alternative offloading policies. The net total cost of each policy is identified, where net total cost is defined as the increase in investment minus the reductions in lost material, disposed material, offload processing

costs and requisition processing costs.

Simulations were made varying days between offload, varying the ERL, and varying SUADPS (Shipboard Uniform Automated Data Processing System) parameters that impact heavily on inventory management.

II. APPROACH

Analyses were performed for one AS(FBM) (Fleet Ballistic Missile) tender and one attack AS(SSN) tender. The data bases used in the analyses, the alternatives considered, and the major evaluation measures are described below. The simulation model used to obtain the evaluation measures is also described.

A. DATA BASE. Evaluations were made for the following two ships: (1) USS HOLLAND - AS(FBM) 32; (2) USS ORION - AS 18. Actual tender MRF (Master Record File) allowance and demand data were used. Historical demands covering the period September 1975 through April 1978 were acquired from the USS HOLLAND. Historical demands covering the period November 1975 through May 1978 were acquired for the USS ORION.

A profile of the MRF data for each test ship is shown in TABLE I. Statistics are shown separately for APA (Appropriation Purchases Account) and NSA (Navy Stock Account) items. The universe of items for this study included all items which had at least one demand or had an allowance quantity, i.e., a load list, COSAL, or TYCOM (Type Commander) add quantity. The items with an allowance, but no demand, normally are not candidates for offload, since the on-hand quantity should not exceed the original allowance. Similarly, items with fixed levels, i.e., fixed RO (Requisitioning Objective) and RP (Reorder Point), are normally not candidates for offload since the on-hand quantity should never exceed the authorized RO.

All evaluation statistics in this study were based on the last 12 months of data. The first 20 months of data for the USS HOLLAND and the first 19 months of data for the USS ORION were used only to initialize the assets and authorized inventory levels at a representative position.

TABLE I
DATA BASE PROFILE

	USS HOLLAND		USS ORION	
APA Items	8,115		1,878	
No Demand	4,330	(53%)	414	(22%)
Demand	3,785	(47%)	1,464	(78%)
Fixed Levels	1,031	(27%)*	909	(62%)*
NSA Items	64,921		42,456	
No Demand	28,296	(44%)	16,657	(39%)
Demand	36,625	(56%)	25,799	(61%)
Fixed Levels	457	(1%)*	1,108	(4%)*
* Represents the percent of demand items that had fixed levels.				

B. ALTERNATIVE POLICIES. The major emphasis in this study was measuring the impact of changing the number of days between offload, changing the DBI qualification/retention criteria, and changing the ERL value. However, changes to the SLF (Safety Level Factor) and the OLMF (Operating Level Multiplier Factor) were also examined. These two

SUADPS parameters have a significant impact on the DBI inventory levels as described in APPENDIX B.

Currently an offload is required every 90 days. Most tenders offload every 30 days to keep the percent of excess material on-board small. Alternatives considered were a 30 day offload, a 360 day offload, and no offload over the total 31-32 month evaluation period.

The current DBI qualification criterion is two demand requisitions in six months. The current DBI retention criterion is one demand in six months. Alternatives considered were one demand in 12 months to remain DBI; three demand requisitions in six months to become DBI; and three demand requisitions in six months to become DBI for allowance items (load list, COSAL, and TYCOM adds), but two demands in six months to become DBI for all other items.

When the total dollar value of long supply for an item is less than the ERL value, it is considered uneconomical to offload and, thus, no offload for that item is required. Currently the ERL is \$10. The alternatives considered in this study were \$50 and \$100.

The benchmark SLF and OLMF, as recommended by SUBLANT (Commander Submarine Force, U. S. Atlantic Fleet), are 2.0 and 10.0, respectively. The alternatives considered were a SLF of 1.0 and an OLMF of 5.0.

C. EVALUATION MEASURES. The major evaluation measures used in this study are \$OH + DI, % change, number items offloaded, \$ offloaded, number of resupply orders/DTOs (Direct Turnovers), gross requisition effectiveness, gross unit effectiveness, and net total cost. These

measures are described below. APA items were evaluated together with the NSA items for each tender.

- . \$OH + DI. The dollar value of the sum of the on-hand and the due-in stock at the end of the simulation for all items.
For information purposes, the \$OH + DI is also shown by NSA/ APA in APPENDIX C.
- . % Change. The percent of change in \$OH + DI from the benchmark, where the benchmark represents current procedures.
- . Number Items Offloaded. The number of items with ULS greater than zero at the time of offload. This count was accumulated over the last year of simulation.
- . \$ Offloaded. The dollar value of the items with ULS greater than zero at time of offload. This value was accumulated over the last year of simulation.
- . Number of Resupply Orders/DTOs. The sum of the number of resupply orders and DTO requisitions placed. Both counts were accumulated over the last year of the simulation. This value is an indicator of the workload in processing requisitions and subsequently receiving, recording and stowing material.
- . Gross Requisition Effectiveness. This statistic is computed

by dividing the number of requisitions totally or partially satisfied during the last year of the simulation by the number of requisitions placed during the same year of the simulation. Net requisition effectiveness, i.e., requisition effectiveness for the carried items, was not a major evaluation measure in this study, but is provided in APPENDIX C for information.

- Gross Unit Effectiveness. This statistic is computed by dividing the number of units satisfied during the last year of the simulation by the number of units demanded during the same year of the simulation. Net unit effectiveness, i.e., unit effectiveness for carried items, was not a major evaluation measure in this study, but is provided in APPENDIX C for information.
- Net Total Cost. This figure represents the change in \$OH + DI from the benchmark minus the total savings that would be expected under the alternative criteria. Total savings include (1) the reduction in unmatched OSO transfers, i.e., the reduction in lost material, (2) the reduction in disposed material, (3) the reduction in offload processing costs, and (4) the reduction in replenishment/DTO processing costs.

$$\begin{aligned} \text{Net Total Cost} = & [(\$OH + DI)_A - (\$OH + DI)_{BM}] - (UT_{BM} - UT_A) \\ & - (D_{BM} - D_A) - (OP_{BM} - OP_A) - (RPC_{BM} - RPC_A) \end{aligned}$$

where

$(\$OH + DI)_{BM} = \$OH + DI$ for the benchmark (current)
criteria

$(\$OH + DI)_A = \$OH + DI$ for the specified alternative
criteria

UT = dollar value of unmatched OSO transfers (lost
material) = 20% x \$ offloaded. Unmatched OSO
transfers are a problem unique to FBM tenders.

Therefore, the reduction in unmatched OSO transfers
was not included in the USS ORION analysis.

D = dollar value of disposed material = 40% x \$ offloaded

OP = offload processing costs = \$50 x number items
offloaded

RPC = replenishment/DTO requisition processing costs
= \$50 x number of resupply orders/DTOs

NOTE: The dollar values and percentages used to
compute UT, D, OP, and RPC are estimates pro-
vided by personnel from PMOLANT (POLARIS
Missile Office, U. S. Atlantic Fleet) and NSC
Charleston in January 1978.

A negative value for net total cost indicates a reduction in overall
costs, while a positive value indicates an increase in overall costs.

It should be noted that the value of $\$OH + DI$ is largely depen-
dent on the timing of the offloads. The policies examined in this

study included 30 day, 90 day and 360 day offloads and a no offload policy. The timing of the offload was measured from the first day of the simulation. The \$OH + DI statistic was computed at the end of the simulation, i.e., after 32 months for the USS HOLLAND and after 31 months for the USS ORION. In order to determine the inventory growth for each policy, the \$OH + DI statistic was also computed at the end of the eighth and 20th months for the USS HOLLAND and the end of the seventh and 19th months for the USS ORION.

For a 30 day offload policy, the \$OH + DI was computed immediately after an offload was performed and, therefore, represents the exact inventory position without ULS. For the 90 day offload policy, however, the \$OH + DI statistic was computed two months after the latest offload for the USS HOLLAND and one month after the latest offload for the USS ORION. This timing approximates the midpoint between offloads and thus represents an inventory position with an average value of ULS. Similarly, the \$OH + DI computed for the 360 day offload policy approximates an inventory position for an average value of ULS. For this policy, the \$OH + DI was computed eight months after the latest offload for the USS HOLLAND and seven months after the latest offload for the USS ORION. The \$OH + DI statistic computed for the no offload policy represents an exact inventory position since no offloads were performed.

D. SIMULATION MODEL. The alternative policies described earlier were evaluated through use of a computer simulation program modeling the

SUADPS-207 Demand Processing/Levels Computation Program. The supply procedures of each ship were incorporated into this program.

Initially, each item was designated non-DBI. The R0 and on-hand quantity for each fixed level item were initialized at the R0 quantity in the ship's MRF. For all other items, the R0 and on-hand quantity were set equal to the allowance quantity for the item on the MRF. The first 20 months of demand for the USS HOLLAND were used as the initialization period for the simulation. For the USS ORION, the first 19 months were used as the initialization period. For both tenders, the final year of demand history from the MRF was used for evaluation purposes.

The simulator processing rules and levels computation rules are described in APPENDIX B. It is noted that a submarine tender may maintain a level of ULS up to 5% of the SAL. However, for this study, all ULS material was offloaded whenever an offload occurred. Additionally total assets (including due-in) were reviewed monthly. If the total assets exceeded the R0, all due-in assets above the R0 were considered to be unauthorized and the most recent orders were cancelled until the total assets were less than or equal to the item's R0.

III. FINDINGS

The benchmark policies used in this study were an offload every 90 days, two demand requisitions in six months to become a DBI, one demand in six months to remain a DBI, an ERL of \$10, a SLF value of 2.0 months, and an OLMF value of 10.0. The evaluation measures using these benchmark values are shown in TABLE II.

TABLE II
BENCHMARK EVALUATION MEASURES

	USS HOLLAND	USS ORION
\$OH + DI	\$17,943.9K	\$3,993.2K
Number Items Offloaded	4,437	2,860
\$ Offloaded	\$ 799.6K	\$ 372.7K
Number Resupply Orders/DTOs	75,096	36,491
Gross Requisition Effectiveness	80.0%	73.4%
Gross Unit Effectiveness	67.8%	66.4%

This study evaluates alternative policies that affect offloading. First, an offload every 90 days will be compared to a 30 day offload, a 360 day offload, and no offload. Various DBI qualification criteria and DBI retention criteria will then be examined. An ERL of \$10 will be compared to an ERL of \$50 and \$100. Finally, combinations of the above alternatives will be evaluated along with changes in the SLF and OLMF. Throughout the remainder of this report, only the criteria specified differ from the benchmark. Criteria not specified are

identical to the benchmark.

A. TIMING OF OFFLOADS. Currently an offload is required every 90 days. However, most tenders offload every 30 days to keep the percent of excess material on-board small and to reduce the manpower requirement at any offload. The 90 day offload policy is compared to a 30 day offload, a 360 day offload, and no offload over the 31-32 month simulation. The intent of the no offload policy is to estimate the impact of offloading only at the time of major overhaul, which is approximately every five years.

1. FBM Tender. TABLE III compares the alternative timing policies for the USS HOLLAND. The 30 day offload policy decreased the \$OH + DI but increased the total items offloaded, \$ offloaded and the resupply/DTO workload. The 360 day offload and no offload policies increased \$OH + DI but decreased the total items offloaded, \$ offloaded and the resupply/DTO workload. The simulated effectiveness impact of each alternative was within approximately 1% of the benchmark. A change of this magnitude for a simulation program is not considered significant.

The net total cost decreased for each alternative policy. The smallest decrease was observed for the 360 day offload policy, while the largest decrease was observed for the no offload policy. Although the no offload policy appears to be the most cost-effective, it should be noted that some items will eventually have to be offloaded.

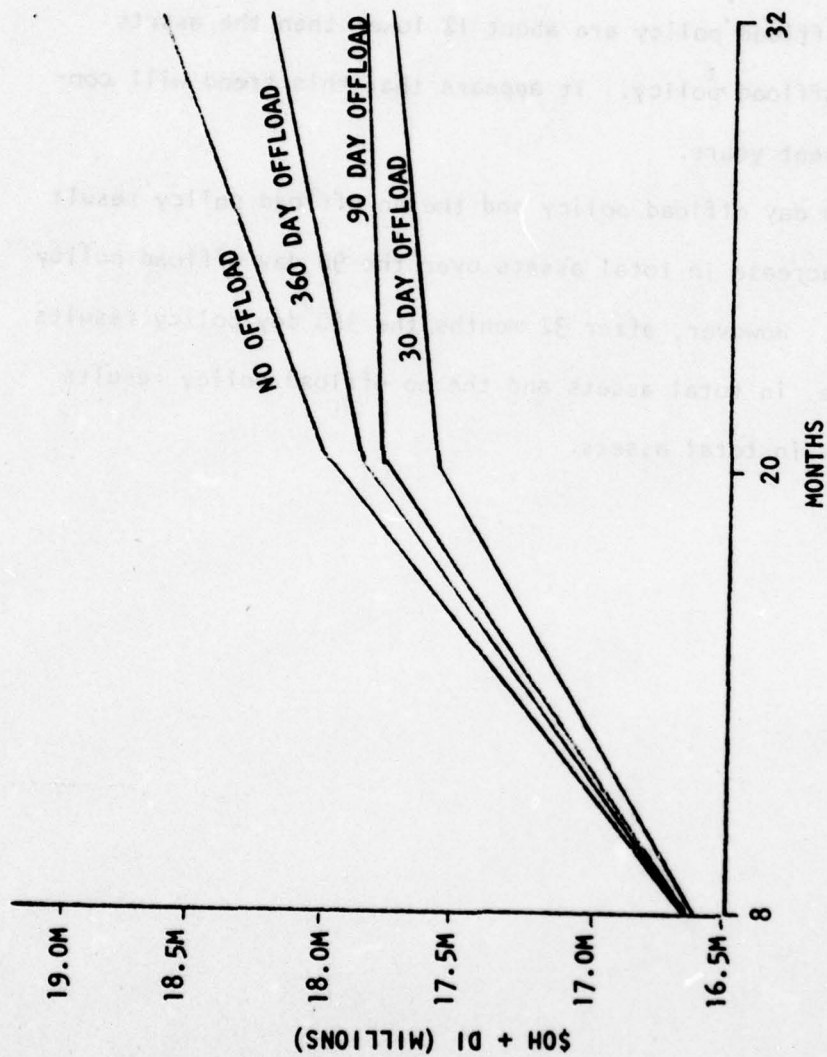
TABLE III
ALTERNATIVE OFFLOAD TIMING POLICIES
(USS HOLLAND)

ALTERNATIVE	\$OH + DI	% CHANGE	NUMBER ITEMS OFFLOADED	\$ OFFLOADED	NUMBER RESUPPLY ORDERS/DTOS	GROSS REQN EFF	GROSS UNIT EFF	NET TOTAL COST
<u>Benchmark</u>								
90 day offload	17,943.9K	-	4,437	799.6K	75,096	80.0%	67.8%	-
30 day offload	-152.0K	-.8%	+644	+27.3K	+659	-.3%	-.3%	-70.4K
360 day offload	+297.3K	+1.7%	-1,733	-310.8K	-1,575	+.6%	+.6%	-54.7K
No offload	+704.3K	+3.9%	-4,437	-799.6K	-3,391	+1.2%	+1.2%	-166.9K*

*Some items will have to eventually be offloaded; however, the total cost for this offload cannot be quantified. Thus, the net total cost for this alternative is understated.

The growth in the on-hand plus due-in inventory level for each policy is depicted in FIGURE 1, based on observations taken after eight months, 20 months, and 32 months. The total assets are virtually the same as eight months. At 20 months and at 32 months, the assets for the 30 day offload policy are about 1% lower than the assets for the 90 day offload policy. It appears that this trend will continue in subsequent years.

Both the 360 day offload policy and the no offload policy result in about a 1% increase in total assets over the 90 day offload policy after 20 months. However, after 32 months the 360 day policy results in a 2% increase in total assets and the no offload policy results in a 4% increase in total assets.



GROWTH IN \$OH + DI FOR ALTERNATIVE OFFLOAD TIMING
POLICIES (USS HOLLAND)

FIGURE 1

2. SSN Tender. TABLE IV compares the 90 day offload policy to a 30 day offload, a 360 day offload, and no offload for the USS ORION. The 30 day offload policy decreased the \$OH + DI but increased the total items offloaded, \$ offloaded and the resupply/DTO workload. The 360 day offload and no offload policies increased \$OH + DI but decreased the total items offloaded, \$ offloaded and the resupply/DTO workload. The simulated effectiveness impact of all but the no offload policy was within 1% of the benchmark. The no offload policy resulted in a 2% increase in gross requisition effectiveness and about a 3% increase in gross unit effectiveness.

The net total cost did not change substantially for the 30 day offload policy, increased for the 360 day offload policy, and decreased for the no offload policy. Although the no offload policy again appears to be the most cost-effective, some items will eventually have to be offloaded.

TABLE IV
ALTERNATIVE OFFLOAD TIMING POLICIES
(USS ORION)

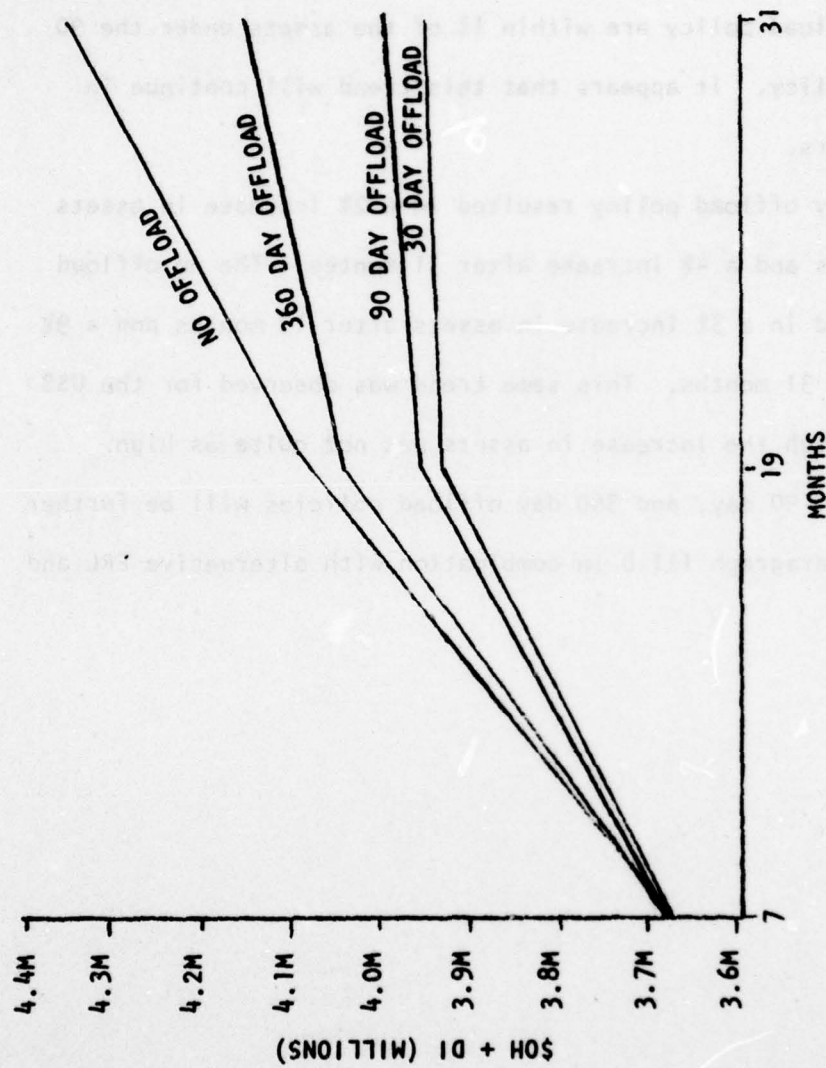
ALTERNATIVE	\$OH + DI	% CHANGE	NUMBER ITEMS OFFLOADED	\$ OFFLOADED	NUMBER RESUPPLY ORDERS/DTOs	GROSS REQN EFF	GROSS UNIT EFF	NET TOTAL COST
<u>Benchmark</u> 90 day offload	3,993.2K	-	2,860	372.7K	36,491	73.4%	66.4%	-
30 day offload	-44.5K	-1.1%	+272	+38.5K	+358	-.4%	-.3%	+2.4K
360 day offload	+159.0K	+4.0%	-859	-129.7K	-800	+8%	+1.0%	+24.1K
No offload	+354.6K	+8.9%	-2,860	-372.7K	-1,997	+2.0%	+2.8%	-37.4K*

*Some items will have to eventually be offloaded; however, the total cost for this offload cannot be quantified. Thus, the net total cost for this alternative is understated.

The growth in on-hand plus due-in inventory level for each policy is depicted in FIGURE 11, based on observations taken after seven months, 19 months, and 31 months. The total assets are virtually the same at seven months. At 19 months and 31 months the assets under the 30 day offload policy are within 1% of the assets under the 90 day offload policy. It appears that this trend will continue in subsequent years.

The 360 day offload policy resulted in a 2% increase in assets after 19 months and a 4% increase after 31 months. The no offload policy resulted in a 3% increase in assets after 19 months and a 9% increase after 31 months. This same trend was observed for the USS HOLLAND, although the increase in assets was not quite as high.

The 30 day, 90 day, and 360 day offload policies will be further evaluated in paragraph III.D in combination with alternative ERL and DBI criteria.



GROWTH IN \$OH + DI FOR ALTERNATIVE OFFLOAD TIMING
POLICIES (US\$ ORION)

FIGURE 11

B. DBI QUALIFICATION/RETENTION CRITERIA. Currently an item must experience two demand requisitions within a six month period to qualify as a DBI. To remain a DBI, an item must continue to experience one demand every six months.

A less stringent DBI retention criterion will decrease the number of items changing from DBI to non-DBI, which will also result in less items offloaded. The increased number of items remaining DBI may increase tender effectiveness; however, this may also increase the tender's asset investment. The impact of using the current DBI qualification criterion, but a less stringent DBI retention policy of one demand in 12 months, was evaluated.

A stricter qualification criterion will result in fewer DBIs, thereby reducing tender range and dollar investment. A stricter qualification criterion will also eliminate the more sporadic demand items from DBI and thus reduce the number of candidates for offloading. However, such a reduction in DBIs may also decrease tender effectiveness. In an attempt to reduce the offloads with minimal impact on effectiveness, the DBI qualification criterion was increased to three frequencies in six months for allowance items, i.e., for load list, COSAL, and TYCOM add items, but retained at two frequencies in six months for all other items. In both cases the current DBI retention criterion of one frequency in six months was used. A DBI qualification criterion of three frequencies in six months for all items is not evaluated here, but will be examined in combination with other policy

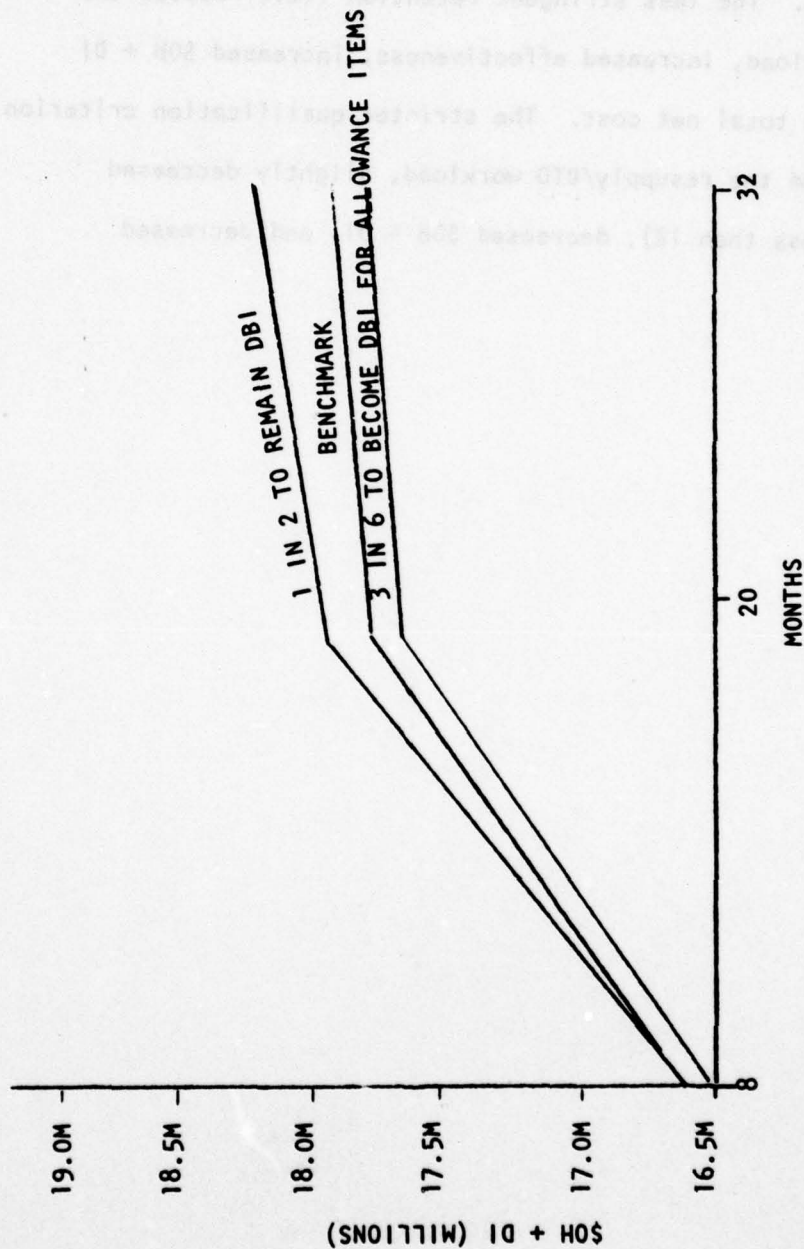
changes later in this study.

1. FBM Tender. TABLE V shows that the less stringent retention limit resulted in about a 2% increase in total assets, while the stricter qualification policy resulted in about a 1% reduction in total assets. Both alternatives resulted in less items offloaded than the benchmark. The total cost of the items offloaded was also less using either alternative. The less stringent retention criterion resulted in a reduced resupply/DTO workload, whereas the stricter qualification policy resulted in a slightly increased resupply/DTO workload. The effectiveness impact of either of these alternatives was within approximately 1% of the benchmark. The net total cost decreased under both alternatives, but the stricter qualification policy reduction was three times greater than the less stringent retention criterion.

TABLE V
ALTERNATIVE DBI QUALIFICATION/RETENTION CRITERIA
(USS HOLLAND)

ALTERNATIVE	\$OH + DI	% CHANGE	NUMBER ITEMS OFFLOADED	\$ OFFLOADED	NUMBER RESUPPLY ORDERS/DTOS	GROSS REQN EFF	GROSS UNIT EFF	NET TOTAL COST
Benchmark 2 in 6 to qualify/ 1 in 6 to remain	17,943.9K	-	4,437	799.6K	75,096	80.0%	67.8%	-
1 in 12 to remain	+363.4K	+2.0%	-2,025	-379.8K	-1,869	+1.1%	+1.2%	-59.1K
3 in 6 to qualify for allowance items	-118.0K	-.7%	-1,089	-77.1K	+409	-.3%	-.4%	-198.3K

FIGURE III shows the growth in the inventory level for each policy, based on observations at eight months, 20 months, and 32 months. The stricter qualification criterion consistently resulted in about a 1% reduction in total assets from the benchmark. The less stringent retention criterion resulted in the same total assets as the benchmark at eight months, but an increase in total assets of about 1% at 20 months and about 2% at 32 months.



GROWTH IN \$OH + DI FOR ALTERNATIVE DBI CRITERIA
(USS HOLLAND)

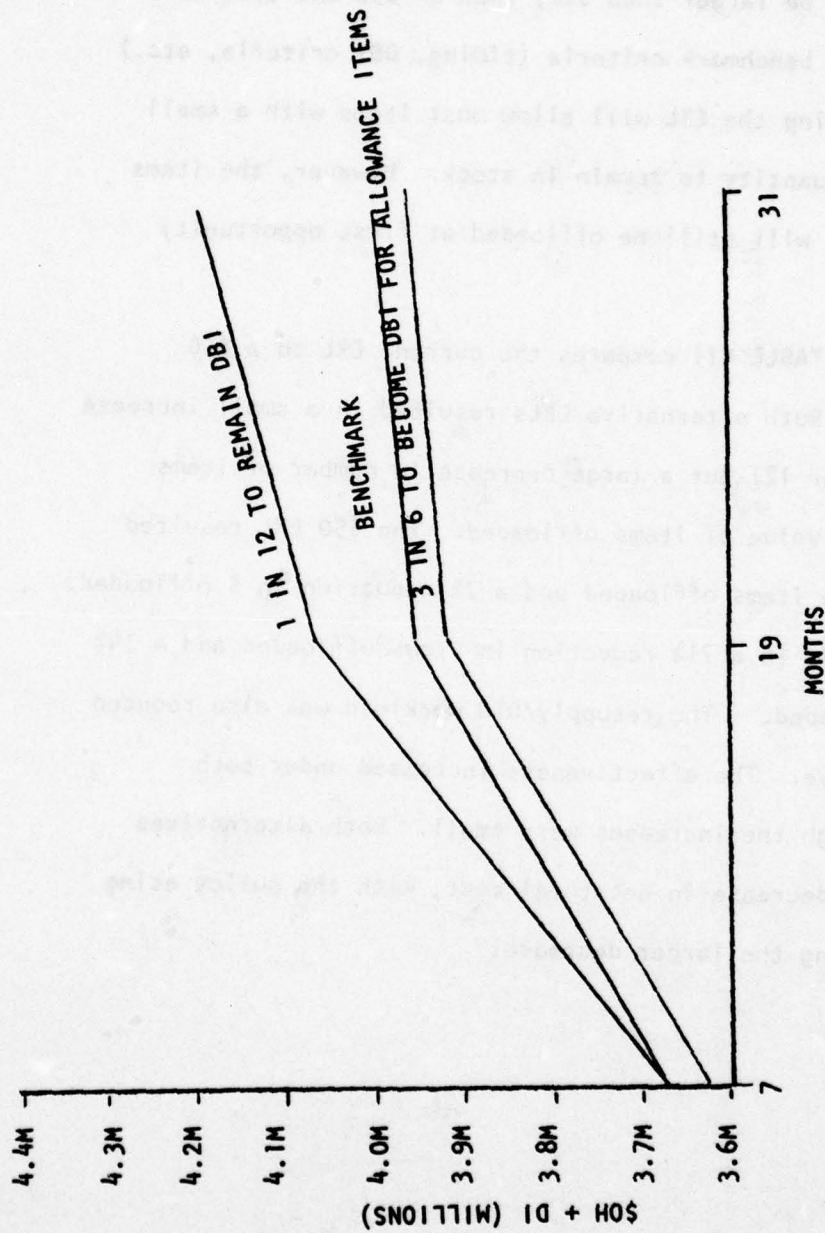
FIGURE III

2. SSN Tender. TABLE VI shows that both the stricter qualification policy and the less stringent retention criterion decreased the number of items offloaded and the dollar value of items offloaded for the USS ORION. The less stringent retention limit reduced the resupply/DTO workload, increased effectiveness, increased \$OH + DI and increased the total net cost. The stricter qualification criterion slightly increased the resupply/DTO workload, slightly decreased effectiveness (less than 1%), decreased \$OH + DI, and decreased total net cost.

TABLE VI
ALTERNATIVE DBI QUALIFICATION/RETENTION CRITERIA
(USS ORION)

ALTERNATIVE	\$OH + DI	% CHANGE	NUMBER ITEMS OFFLOADED	\$ OFFLOADED	NUMBER RESUPPLY ORDERS/DTOS	GROSS REQN EFF	GROSS UNIT EFF	NET TOTAL COST
Benchmark 2 in 6 to qualify/ 1 in 6 to remain	3,993.2K	-	2,860	372.7K	36,491	73.4%	66.4%	-
1 in 12 to remain	+205.6K	+5.1%	-1,006	-170.6K	-1,131	+2.0%	+1.9%	+30.4K
3 in 6 to qualify for allowance items	-31.1K	-.8%	-476	-27.8K	+387	-.2%	-.6%	-46.6K

FIGURE IV shows the growth in the inventory level for each policy based on observations at seven months, 19 months, and 31 months. The stricter qualification criterion consistently resulted in about a 1% reduction in total assets for the benchmark. The less stringent retention criterion resulted in the same total assets as the benchmark at seven months, but an increase in total assets of about 3% at 19 months and about 5% at 31 months. The same trend was observed for the USS HOLLAND, although the increase in $\$OH + DI$ was not quite as high. DBI qualification and retention criteria will be further evaluated in Section III.D in combination with alternative timing and ERL policies.



GROWTH IN \$OH + DI FOR ALTERNATIVE DBI CRITERIA
(USS ORION)

FIGURE IV

C. ECONOMIC RETENTION LEVEL. It is considered uneconomical to offload any item for which the dollar value of ULS is less than the ERL. Currently the ERL is set at \$10. Since the total cost of offloading an item is assumed to be larger than \$10, ERLs of \$50 and \$100 were evaluated. All other benchmark criteria (timing, DBI criteria, etc.) were unchanged. Raising the ERL will allow most items with a small unit price or small quantity to remain in stock. However, the items with large unit price will still be offloaded at first opportunity after becoming ULS.

1. FBM Tender. TABLE VII compares the current ERL to a \$50 ERL and a \$100 ERL. Both alternative ERLs resulted in a small increase in total assets (under 1%) but a large decrease in number of items offloaded and dollar value of items offloaded. The \$50 ERL resulted in a 52% reduction in items offloaded and a 7% reduction in \$ offloaded. The \$100 ERL resulted in a 71% reduction in items offloaded and a 14% reduction in \$ offloaded. The resupply/DTO workload was also reduced under each alternative. The effectiveness increased under both alternatives, although the increases were small. Both alternatives resulted in a large decrease in net total cost, with the policy using the \$100 ERL producing the larger decrease.

TABLE VII
ALTERNATIVE ECONOMIC RETENTION LEVELS
(US\$ HOLLAND)

ALTERNATIVE	\$OH + DI	% CHANGE	NUMBER ITEMS OFFLOADED	\$ OFFLOADED	NUMBER RESUPPLY ORDERS/DTOs	GROSS REQN EFF	GROSS UNIT EFF	NET TOTAL COST
Benchmark \$10 ERL	17,943.9K	-	4,437	799.6K	75,096	80.0%	67.8%	-
\$50 ERL	+48.8K	+ .3%	-2,320	-54.6K	-1,882	+ .5%	+ .3%	-194.1K
\$100 ERL	+96.7K	+ .5%	-3,162	-113.7K	-2,468	+ .8%	+1.0%	-253.0K

2. SSN Tender. TABLE VIII compares the current \$10 ERL to a \$50 ERL and a \$100 ERL for the USS ORION. The \$50 ERL resulted in about a 1% increase in total assets, whereas the \$100 ERL resulted in about a 2% increase over the benchmark. The \$50 ERL resulted in a 55% reduction in items offloaded and a 10% reduction in \$ offloaded. The \$100 ERL resulted in a 73% reduction in items offloaded and a 20% reduction in \$ offloaded. The resupply/DTO workload was also reduced under each alternative. The effectiveness increased under both alternatives. Using a \$50 ERL resulted in about a 1% increase over the benchmark policy, whereas using a \$100 ERL resulted in about a 1.5% increase in effectiveness. Both alternatives resulted in a large decrease in net total cost, with the policy using the \$100 ERL producing the larger decrease.

TABLE VIII
ALTERNATIVE ECONOMIC RETENTION LEVELS
(US\$ ORION)

ALTERNATIVE	\$OH + DI	% CHANGE	NUMBER ITEMS OFFLOADED	\$ OFFLOADED	NUMBER RESUPPLY ORDERS/DTOS	GROSS REQN EFF	GROSS UNIT EFF	NET TOTAL COST
Benchmark \$10 ERL	3,993.2K	-	2,860	372.7K	36,491	73.4%	66.4%	-
\$50 ERL	+39.2K	+1.0%	-1,559	-38.6K	-1,115	+1.0%	+1.1%	-110.0K
\$100 ERL	+72.3K	+1.8%	-2,089	-75.5K	-1,519	+1.5%	+1.6%	-138.3K

D. COMBINATIONS OF ALTERNATIVES. TABLES IX and X show the benchmark policy along with the seven alternatives previously considered. It should be noted that for both tenders, changes in the ERL had a much greater effect on net total cost than the timing of the offload. The stricter DBI qualification criterion for allowance items also had a much greater effect on net total cost than the timing of the offload.

Several combinations of timing, ERL, and DBI criteria, as shown in TABLE XI, are evaluated in this section. Combinations A through E all use the same DBI qualification criteria, specifically three frequencies in six months for allowance items and two frequencies in six months for all other items. Changing the DBI qualification criteria so that the policy for allowance items is stricter than for all other items requires either a change to the current SUADPS levels setting program or running the current program once for allowance items and once for all other items. To avoid program changes, two other combinations of alternatives were also evaluated. Combination F uses a 30 day offload, an ERL of \$100 and a DBI qualification of two demand requisitions in six months. Combination G uses a 30 day offload, an ERL of \$100 and a DBI qualification criterion of three demand requisitions in six months.

TABLE IX
SUMMARY OF ALTERNATIVE TIMING, DBI, AND ERL POLICIES
(USS HOLLAND)

ALTERNATIVE ¹	\$OH + DI	% CHANGE	NUMBER ITEMS OFFLOADED	\$ OFFLOADED	NUMBER RESUPPLY ORDERS/DTOS	GROSS REQN EFF	GROSS UNIT EFF	NET TOTAL COST
Benchmark 90 day offload \$10 ERL 2 in 6 to qualify/ 1 in 6 to remain DBI	17,943.9K	-	4,437	799.6K	75,096	80.0%	67.8%	-
30 day offload	-152.0K	-.8%	+644	+27.3K	+659	-.3%	-.3%	-70.4K
360 day offload	+297.3K	+1.7%	-1,733	-310.8K	-1,575	+.6%	+.6%	-54.7K
No offload	+704.3K	+3.9%	-4,437	-799.6K	-3,391	+1.2%	+1.2%	-166.9K ²
1 in 12 to remain DBI	+363.4K	+2.0%	-2,025	-379.8K	-1,869	+1.1%	+1.2%	-59.1K
3 in 6 to qualify DBI for allowance items	-118.0K	-.7%	-1,089	-77.1K	+409	-.3%	-.4%	-198.3K
\$50 ERL	+48.8K	+.3%	-2,320	-54.6K	-1,882	+.5%	+.3%	-194.1K
\$100 ERL	+96.7K	+.5%	-3,162	-113.7K	-2,468	+.8%	+1.0%	-253.0K

¹Criteria not specified for each line are identical to the benchmark.

²Some items will have to eventually be offloaded; however, the total cost for this offload cannot be quantified. Thus, the net total cost is understated.

TABLE X
SUMMARY OF ALTERNATIVE TIMING, DBI, AND ERL POLICIES
(USS ORION)

ALTERNATIVE ¹	\$OH + DI	% CHANGE	NUMBER ITEMS OFFLOADED	\$ OFFLOADED	NUMBER RESUPPLY ORDERS/DTOs	GROSS REQN EFF	GROSS UNIT EFF	NET TOTAL COST
<u>Benchmark</u> 90 day offload \$10 ERL 2 in 6 to qualify/ 1 in 6 to remain DBI	3,993.2K	-	2,860	372.7K	36,491	73.4%	66.4%	-
30 day offload	-44.5K	-1.1%	+272	+38.5K	+358	-.4%	-.3%	+2.4K
360 day offload	+159.0K	+4.0%	-859	-129.7K	-800	+8%	+1.0%	+24.1K
No offload	+354.6K	+8.9%	-2,860	-372.7K	-1,997	+2.0%	+2.8%	-37.4K ²
1 in 12 to remain DBI	+205.6K	+5.1%	-1,006	-170.6K	-1,131	+2.0%	+1.9%	+30.4K
3 in 6 to qualify DBI for allowance items	-31.1K	-.8%	-476	-27.8K	+387	-.2%	-.6%	-46.6K
\$50 ERL	+39.2K	+1.0%	-1,559	-38.6K	-1,115	+1.0%	+1.1%	-110.0K
\$100 ERL	+72.3K	+1.8%	-2,089	-75.5K	-1,519	+1.5%	+1.6%	-138.3K

¹Criteria not specified for each line are identical to the benchmark.

²Some items will have to eventually be offloaded; however, the total cost for this offload cannot be quantified. Thus, the net total cost is understated.

TABLE XI
ALTERNATIVE COMBINATION POLICIES

ALTERNATIVE	TIMING OF OFFLOAD	ECONOMIC RETENTION LEVEL	DBI CRITERIA QUALIFY/RETAIN
Benchmark	90 days	\$10	2 in 6/1 in 6
Combination A	30 days	\$100	3 in 6/1 in 6 for allowance items 2 in 6/1 in 6 otherwise
Combination B	90 days	\$100	Same as A
Combination C	360 days	\$100	Same as A
Combination D	30 days	\$100	3 in 6/1 in 12 for allowance items 2 in 6/1 in 12 otherwise
Combination E	90 days	\$50	Same as A
Combination F	30 days	\$100	2 in 6/1 in 6
Combination G	30 days	\$100	3 in 6/1 in 6

1. FBM Tender. As shown in TABLE XII, all the alternatives reduced the number of offloads, the dollar value of items offloaded, the resupply order/DTO workload, and the net total cost. Combination G is the only policy that decreased effectiveness, and that decrease was less than 1%. Combination A produced the greatest reduction in \$OH + DI and in net total cost without decreasing effectiveness. All the alternatives shown in TABLE XII reduced the number of offloads over 50% with less than 1% impact on effectiveness and a maximum 1.2% growth in inventory dollar value.

2. SSN Tender. Combination C used in the FBM tender part of this study was not examined here since the 360 day offload policy had a higher net total cost than either the 30 day offload or 90 day offload policy when timing of offloads was examined. As shown in TABLE XIII, all the other combinations reduced the number of offloads, the dollar value of items offloaded, the resupply order/DTO workload, and the net total cost. Combination A produced the greatest reduction in \$OH + DI and in net total cost without decreasing effectiveness. All the alternatives shown in TABLE XIII reduced the number of offloads by over 50%. Only Combination G had a negative impact on effectiveness, while Combination D was the only policy with over 1% growth in \$OH + DI.

TABLE XII
COMBINATIONS OF ALTERNATIVES
(USS HOLLAND)

ALTERNATIVE	\$OH + DI	% CHANGE	NUMBER ITEMS OFFLOADED	\$ OFFLOADED	NUMBER RESUPPLY ORDERS/DTOs	GROSS REQN EFF	GROSS UNIT EFF	NET TOTAL COST
Benchmark	17,943.9K	-	4,437	799.6K	75,096	80.0%	67.8%	-
Combination A	-176.2K	-1.0%	-3,162	-154.4K	-1,367	+3%	+4%	-495.3K
Combination B	-52.5K	-.3%	-3,337	-160.0K	-1,579	+4%	+5%	-394.2K
Combination C	+183.5K	+1.0%	-3,863	-414.9K	-1,986	+6%	+6%	-357.9K
Combination D	+210.0K	+1.2%	-3,789	-417.9K	-1,684	+9%	+1.0%	-314.5K
Combination E	-85.9K	-.5%	-2,708	-116.0K	-1,095	+2%	+2%	-345.7K
Combination F	-32.3K	-.2%	-2,967	-103.7K	-2,231	+7%	+9%	-354.5K
Combination G	-417.4K	-2.3%	-3,465	-298.0K	-2,662	-.9%	-.3%	-902.6K

TABLE XIII
COMBINATIONS OF ALTERNATIVES
(US\$ ORION)

ALTERNATIVE	\$OH + DI	% CHANGE	NUMBER ITEMS OFFLOADED	\$ OFFLOADED	NUMBER RESUPPLY ORDERS/DTOS	GROSS REQN EFF	GROSS UNIT EFF	NET TOTAL COST
Benchmark	3,993.2K	-	2,860	372.7K	36,491	73.4%	66.4%	-
Combination A	-8.3K	-.2%	-2,054	-61.0K	-777	+1.2%	+.9%	-174.3K
Combination B	+25.2K	+.6%	-2,141	-89.4K	-868	+1.3%	+.9%	-161.0K
Combination D	+172.1K	+4.3%	-2,392	-197.3K	-889	+2.1%	+1.9%	-70.9K
Combination E	-2.2K	-.1%	-1,686	-58.1K	-510	+.8%	+.5%	-135.2K
Combination F	+35.7K	+.9%	-1,986	-43.8K	-1,422	+1.4%	+1.6%	-152.2K
Combination G	-205.5K	-5.1%	-2,375	-179.4K	-1,577	-1.9%	-1.0%	-475.0K

E. SAFETY LEVEL FACTOR AND OPERATING LEVEL MULTIPLIER FACTOR. The benchmark and all alternatives considered to this point used a SLF of 2.0 months and an OLMF of 10.0. These were the values recommended by SUBLANT.

Raising these values would increase the depth of DBIs. This in turn would increase the amount of excess for items that change from DBI to non-DBI. This increase in excess would result in more items offloaded and more dollar value offloaded. Thus, only decreases in the SLF and the OLMF were considered in this study.

1. FBM Tender. TABLE XIV compares the benchmark to Combination A, Combination A with the OLMF changed to 5.0, and Combination A with the SLF changed to 1.0 month. Changing the Combination A OLMF from 10.0 to 5.0 not only increased the net total cost considerably (reduced savings from 495.3K to 133.7K) but also decreased the effectiveness by about 1%. Changing the SLF from 2.0 months to 1.0 month resulted in a substantial decrease in net total cost, but this was at the expense of about 3% drop in effectiveness. Of the policies considered, the benchmark values for the SLF and OLMF appear to be the best policy for the USS HOLLAND.

TABLE XIV
SAFETY LEVEL FACTOR AND OPERATING LEVEL MULTIPLIER FACTOR
(USS HOLLAND)

ALTERNATIVE	\$OH + DI	% CHANGE	NUMBER ITEMS OFFLOADED	\$ OFFLOADED	NUMBER RESUPPLY ORDERS/DTOs	GROSS REQN EFF	GROSS UNIT EFF	NET TOTAL COST
Benchmark With SLF=2 months and OLMF = 10	17,943.9K	-	4,437	799.6K	75,096	80.0%	67.8%	-
Combination A With SLF=2 months and OLMF = 10	-176.2K	-1.0%	-3,162	-154.4K	-1,367	+3%	+4%	-495.3K
Combination A With SLF=2 months and OLMF = 5	-299.4K	-1.7%	-3,379	-218.4K	+9,316	-6%	-1.1%	-133.7K
Combination A With SLF=1 month and OLMF = 10	-662.7K	-3.7%	-3,328	-320.1K	+2,367	-2.8%	-3.0%	-902.7K

2. SSN Tender. TABLE XV compares the benchmark to Combination A, Combination A with the OLMF changed to 5.0, and Combination A with the SLF changed to 1.0 month. Changing the OLMF in Combination A from 10.0 to 5.0 not only increased the net total cost considerably, but also decreased the requisition effectiveness by about 1% and the unit effectiveness by about 2%. Changing the SLF from two months to one month resulted in a substantial decrease in net total cost, but this was at the expense of about 1% requisition effectiveness and about 2% unit effectiveness. Of the policies considered, the benchmark values for the SLF and OLMF appear to be the best policy for the USS ORION.

TABLE XV
SAFETY LEVEL FACTOR AND OPERATING LEVEL MULTIPLIER FACTOR
(USS ORION)

ALTERNATIVE	\$OH + DI	% CHANGE	NUMBER ITEMS OFFLOADED	\$ OFFLOADED	NUMBER RESUPPLY ORDERS/DTOs	GROSS REQN EFF	GROSS UNIT EFF	NET TOTAL COST
Benchmark With SLF=2 months and OLMF = 10	3,993.2K	-	2,860	372.7K	36,491	73.4%	66.4%	-
Combination A With SLF=2 months and OLMF = 10	-8.3K	-.2%	-2,054	-61.0K	-777	+1.2%	+9%	-174.3K
Combination A With SLF=2 months and OLMF = 5	-73.1K	-1.8%	-2,153	-91.7K	+3,616	+5%	-.8%	-36.7K
Combination A With SLF=1 month and OLMF = 10	-190.7K	-4.8%	-2,185	-159.9K	+78	-.1%	-.9%	-360.0K

IV. SUMMARY

This study estimated the extent of investment growth to be expected under a reduced offloading policy. The study also determined the extent of change in number of items offloaded, dollar value of items offloaded, number of resupply orders and DTO requisitions, effectiveness, and net total cost under alternative offloading policies. Simulations were made varying the time between offloads and varying the ERL.

Additionally, selected SUADPS parameters that impact on inventory investment were evaluated for sensitivity. Specifically, the DBI qualification and retention criteria, the SLF, and the OLMF were varied. Analyses were performed for one AS(FBM) tender and one attack AS(SSN) tender. Results of the alternatives tested are shown in TABLE XVI. The Net Total Cost shown in TABLE XVI was computed as the increase in inventory dollar value minus the savings attributable to reductions in material losses, disposal actions, offload processing costs and requisition processing costs. The contribution of each of these factors to the Net Total Cost is shown in TABLES XVII and XVIII for the USS HOLLAND and USS ORION.

TABLES XVI through XVIII list the alternatives in sequence by the percent reduction in items offloaded. All alternatives below the dashed line reduced offloads by at least 50%. Total elimination of offloads increased the inventory dollar value by 9% at the end of 31 months for the USS ORION and by 4% at the end of 32 months for the USS HOLLAND. Analysis of the growth trends indicate that these percentages would most likely continue to grow over time.

TABLE XVI
SUMMARY COMPARISON OF ALTERNATIVES¹

ALTERNATIVES ¹	USS HOLLAND				USS ORION			
	\$OH + DI	# ITEMS OFFLOADED	GROSS REQN EFF	NET TOTAL COST	\$OH + DI	# ITEMS OFFLOADED	GROSS REQN EFF	NET TOTAL COST
Benchmark	17,944K	4,437	80.0%	-	3,993K	2,860	73.4%	-
30 Day Offload	- .8%	+ 15%	- .3%	- 71K	- 1.1%	+ 10%	- .4%	- 2K
3 in 6 to qualify DBI for allowance items	- .7%	- 25%	- .3%	- 198K	- .8%	- 17%	- .2%	- 47K
360 Day Offload	+ 1.7%	- 39%	+ .6%	- 55K	+ 4.0%	- 30%	+ .8%	+ 24K
1 in 12 to remain DBI	+ 2.0%	- 46%	+ 1.1%	- 59K	+ 5.1%	- 35%	+ 2.0%	+ 30K
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\$50 ERL	+ .3%	- 52%	+ .5%	- 194K	+ 1.0%	- 55%	+ 1.0%	- 110K
Combination E	- .5%	- 61%	+ .2%	- 346K	- .1%	- 59%	+ .8%	- 135K
Combination F	- .2%	- 67%	+ .7%	- 355K	+ .9%	- 69%	+ 1.4%	- 152K
Combination A	- 1.0%	- 71%	+ .3%	- 495K	- .2%	- 72%	+ 1.2%	- 174K
\$100 ERL	+ .5%	- 71%	+ .8%	- 253K	+ 1.8%	- 73%	+ 1.5%	- 138K
Combination B	- .3%	- 75%	+ .4%	- 394K	+ .6%	- 75%	+ 1.3%	- 161K
Combination A with SLF = 1	- 3.7%	- 75%	- 2.8%	- 903K	- 4.8%	- 76%	.1%	- 360K
Combination A with OLMF = 5	- 1.7%	- 76%	- .6%	- 134K	- 1.8%	- 75%	+ .5%	- 37K
Combination G	- 2.3%	- 78%	- .9%	- 903K	- 5.1%	- 83%	- 1.9%	- 475K
Combination D	+ 1.2%	- 85%	+ .9%	- 315K	+ 4.3%	- 84%	+ 2.1%	- 71K
Combination C	+ 1.0%	- 87%	+ .6%	- 358K	---	---	---	---
No Offload	+ 3.9%	- 100%	+ 1.2%	- 167K ²	+ 8.9%	NOT EVALUATED	+ 2.0%	- 37K ²

¹Combination Policies are defined in TABLE XI, page 37.

²Some items will have to eventually be offloaded; however the total cost for this offload cannot be quantified. Thus, the net total cost is understated.

³Denotes alternatives that reduce offloads with less than 2% growth in \$OH + DI and no decrease in effectiveness.

TABLE XVII

BREAKDOWN OF NET TOTAL COST
(USS HOLLAND)

ALTERNATIVES	NET TOTAL COST	\$OH + DI	\$ MATERIAL LOSSES	\$ DISPOSAL	\$ OFFLOAD PROCESSING	\$ REQD PROCESSING
Benchmark	- 71K	-152K	+ 5K	+ 11K	+ 32K	+ 33K
30 Day Offload	-198K	-118K	- 15K	- 31K	- 54K	+ 20K
3 in 6 to qualify DBI for allowance items						
360 Day Offload	- 55K	+297K	- 62K	-124K	- 87K	- 79K
1 in 12 to remain DBI	- 59K	+363K	- 76K	-152K	-101K	- 93K
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\$50 ERL	-194K	+ 49K	- 11K	- 22K	-116K	- 94K
Combination E	-346K	- 86K	- 23K	- 46K	-135K	- 55K
Combination F	-355K	- 32K	- 21K	- 41K	-148K	-112K
Combination A	-495K	-176K	- 31K	- 62K	-158K	- 68K
\$100 ERL	-253K	+ 97K	- 23K	- 45K	-158K	-123K
Combination B	-394K	- 53K	- 32K	- 64K	-167K	- 79K
Combination A with SLF=1	-903K	-663K	- 64K	-128K	-166K	+118K
Combination A with OLMF=5	-134K	-299K	- 44K	- 87K	-169K	+466K
Combination G	-903K	-417K	- 60K	-119K	-173K	-133K
Combination D	-315K	+210K	- 84K	-167K	-189K	- 84K
Combination C	-358K	+184K	- 83K	-166K	-193K	- 99K
No Offload	-167K	+704K	-160K	-320K	-222K	-170K

*Denotes alternatives that reduce offload over 50% with less than 2% growth in \$OH + DI and no decrease in effectiveness.

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TABLE XVIII

BREAKDOWN OF NET TOTAL COST
(USS ORION)

ALTERNATIVES	NET TOTAL COST	\$OH + DI	\$ MATERIAL LOSSES	\$ DISPOSAL	\$ OFFLOAD PROCESSING	\$ REQD PROCESSING
Benchmark	-	-	-	-	-	-
30 Day Offload	+ 2K	- 45K	-	+ 15K	+ 14K	+ 18K
3 in 6 to qualify DBI for allowance items	- 47K	- 31K	-	- 11K	- 24K	+ 19K
360 Day Offload	+ 24K	+159K	-	- 52K	- 43K	- 40K
1 in 12 to remain DBI	+ 30K	+206K	-	- 68K	- 50K	- 57K

\$50 ERL	-110K	+ 39K	-	- 15K	- 78K	- 56K
Combination E	-135K	- 2K	-	- 23K	- 84K	- 26K
Combination F	-152K	+ 36K	-	- 18K	- 99K	- 71K
Combination A	-174K	- 8K	-	- 24K	-103K	- 39K
\$100 ERL	-138K	+ 72K	-	- 30K	-104K	- 76K
Combination B	-161K	+ 25K	-	- 36K	-107K	- 43K
Combination A with SLF=1	-360K	-191K	-	- 64K	-109K	+ 4K
Combination A with OLMF=5	- 37K	- 73K	-	- 37K	-108K	+181K
Combination G	-475K	-206K	-	- 72K	-119K	- 79K
Combination D	- 71K	+172K	-	- 79K	-120K	- 44K
No Offload	- 37K	+355K	-	-149K	-143K	-100K

*Denotes alternatives that reduce offloads over 50% with less than 2% growth in \$OH + DI and no decrease in effectiveness.

* * * * *

Seven alternatives achieved a reduction in offloads of 50% or more and decreased net total cost with less than 2% growth in the dollar investment and no reduction in effectiveness. These alternatives are marked with an asterisk in TABLES XVI through XVIII. The common factor among all seven alternatives is the change in the ERL. Thus, it is recommended that the ERL be increased to achieve a reduction in workload and net total cost.

APPENDIX A: REFERENCES

1. APPENDIX 2 of the SUADPS-207 Executive Handbook - NAVSUP Publication 464 of December 1976.
2. COMSUBLANTINST 4440.2D of 10 Oct 1974.
3. SPCCINST 4440.450 of 22 Dec 1976.

APPENDIX B: SIMULATION MODEL DESCRIPTION

The alternative policies in this study were evaluated through use of a computer simulation program modeling the SUADPS-207 Demand Processing/Levels Computation Program. The supply procedures of each ship were incorporated into this program.

Initially, each item was designated non-DBI. The R0 and on-hand quantity for each fixed level item were initialized at the R0 quantity in the ship's MRF. For all other items the R0 and on-hand quantity were set equal to the allowance quantity for the item on the MRF. The first 20 months of demand for the USS HOLLAND were used as the initialization period for the simulation. For the USS ORION, the first 19 months were used as the initialization period. For both tenders, the final year of demand history from the MRF was used for evaluation purposes.

The following description is a summary of the major events of the simulator:

1. Event: Demand. This event occurred whenever a requisition was placed against the ship's inventory. The two major data elements needed for processing were the date of the requisition within the simulation and the demand quantity. These elements were developed from the ship's MRF demand history. During this event, material, if available, was issued and effectiveness statistics were gathered.

2. Event: Inventory Review. This event occurred every 30 days.

During this event an item's past demand history was reviewed to determine the DBI status. A DBI is a "fast moving" item which is sometimes referred to as a POS (Peacetime Operating Stock) item. To qualify as DBI, an item must meet certain frequency of demand criteria. The criteria calling for two demand requisitions in six months to qualify as DBI and one demand in six months to remain DBI are currently used by all submarine tenders. A non-DBI is an item that does not meet the DBI criteria.

If an item was coded DBI, its demand record was compared with the specified DBI retention rule. If the item was coded non-DBI, a check was imposed to determine if the item met the specified DBI qualification rule. Once an item's DBI/non-DBI status was determined, the appropriate inventory levels were computed. The inventory levels were computed as shown below, in accordance with reference 1 of APPENDIX A.

- . AMD (Average Monthly Demand) is the total quantity of demand experienced over a specified period divided by the number of months in the period.
- . OST (Order and Shipping Time) is a level of stock adequate to satisfy the average demand rate during the anticipated time between placement of a resupply order and receipt of material.
 $OST = OSTF \times AMD$, where OSTF is the Order and Shipping Time Factor. SUBLANT recommended using an OSTF of 1.0. OST was

computed only for DBI.

- . SL (Safety Level) is a level of buffer stock intended to provide protection against abrupt increases of demand that could cause the item to become NIS (Not-in-Stock). $SL = SLF \times AMD$. SUBLANT recommended using a SLF of 2.0. If the computed SL is less than the allowance quantity, the SL is set equal to the allowance quantity. For non-FBM submarine tenders, allowance quantity = COSAL quantity + load list quantity + Nuclear weapons COSAL quantity + TYCOM miscellaneous load list quantity. For FBM submarine tenders, allowance quantity = the greatest quantity among the FMSO (Navy Fleet Material Support Office) load list quantity, Nuclear weapons COSAL quantity, operating space items allowance equipage list quantity, COSAL quantity, SSPO (Strategic Systems Project Office) load list quantity, and the TYCOM miscellaneous load list quantity. SL was computed only for DBI.
- . OL (Operating Level) is a layer of stock provided in addition to the OST and SL, out of which the ship is supposed to conduct its normal peacetime supply operations. The SUADPS levels setting program uses the EOQ (Economic Order Quantity) concept. The EOQ formula considers the AMD, UP (Unit Price), OLMF, and MAX/MIN (maximum/minimum months of supply) constraints.

$OL = OLMF \times \sqrt{\frac{AMD}{UP}}$. The OL was constrained between MIN x AMD and MAX x AMD. SUBLANT recommended using an OLMF of 10.0, a MAX of 12.0 months, and a MIN of 0.5 months. OL was computed only for DBI.

- RO (Requisitioning Objective) is the net asset level to be attained at the time a supply order is initiated. For a non-DBI item, the RO equals the allowance quantity. For a DBI item, the RO equals the sum of the OST, the SL and the OL. In accordance with reference 2 of APPENDIX A, items aboard the USS HOLLAND which satisfied any of the following criteria were considered fixed level items and thus were always treated as non-DBIs: (1) items with cog OA, 2F, 2S, 2Z or 8A; (2) items with a unit price greater than \$500 and cog 2P, 2X, 4P, 6A, 6H, 6N, 6P, 6X, 8P, or 8X. In accordance with reference 3 of APPENDIX A, items aboard the USS ORION which had a MCC (Material Control Code) of E, H, or X in the MRF were considered fixed level items and thus always treated as non-DBIs. These fixed level items were assigned the same RO as on the MRF. Any item on either tender, for which a limit flag was set in the MRF, was assigned the same RO as on the MRF and treated as a non-DBI.
- RP (Reorder Point) is the net asset level at or below which a resupply order is initiated. For a non-DBI item, RP is one

unit less than the R0. For a DBI item, RP equals OST plus SL.

At the conclusion of each inventory review, the total assets (including due-in) for each item were compared with the item's R0. As stated in reference 1 of APPENDIX A, if the R0 was smaller, all on-order assets above the R0 level were considered to be unauthorized. If an item had unauthorized on-order assets, the most recent stock orders for the item were cancelled until the total assets for the item were at most equal to the item's R0.

Although the parameter values cited above may vary slightly from the current operating values used on-board the ships, they fall within the range of recommended values. It is felt that the trends established by the model are a valid indication of what would occur under each alternative criteria.

3. Event: Offload. If an item is a DBI, it has a maximum value of stock authorized equal to the sum of the SL and OL. If an item is non-DBI, it has a maximum value of stock authorized equal to its R0. This maximum value of stock authorized is called the item's SAL. The SAL does not include the OST quantity for items that are DBI since the OST quantity is considered "pipeline support", and no part of the material in the OST pipeline is ever, in theory, aboard ship.

If an item has more material on-hand than the sum of its SAL and one year of predicted demand, this additional material is considered excess or long supply material. If the dollar value for this

long supply equals or exceeds the ERL, the material is considered ULS and should be offloaded from the tender.

This event determines whether an item had ULS. If an item had ULS, the on-hand assets for the item were decreased by the ULS quantity. A submarine tender may maintain a level of ULS up to 5% of its SAL. However, for this study all ULS was offloaded. For the benchmark run this event occurred every 90 days.

4. Event: Review of Assets. This event occurred every 10 days. It reviewed the status of an item's assets based on the inventory levels computed during the event "Inventory Review". Whenever the assets (on-hand plus due-in) were less than or equal to the RP, a resupply order was placed for that item. The quantity of the order was equal to the difference between the R0 and the assets.

5. Event: Receipt. This event occurred upon the arrival of a resupply order placed in the event "Review of Assets". The receipt time, defined as the time from the placing of an order to its arrival, was set at 30 days for the USS ORION and 60 days for the USS HOLLAND, unless otherwise stated in the MRF.

6. Event: Snapshot. This event collected statistics so a review of the system could be taken at arbitrary points of time during the simulation.

APPENDIX C: ADDITIONAL STATISTICS

TABLES I and II provide investment statistics segmented by NSA and APA and provide net effectiveness values for each alternative policy discussed in the main report. These statistics supplement the summarized data in the main report.

TABLE I

ADDITIONAL STATISTICS FOR USS HOLLAND

ALTERNATIVES ¹	\$OH + DI			NET REQN EFF	NET UNIT EFF
	TOTAL	NSA	APA		
Benchmark	17,943.9K	6,100.7K	11,843.2K	89.0%	76.4%
30 Day Offload	-152.0K	-104.6K	-47.4K	-.3%	-.3%
360 Day Offload	+297.3K	+225.9K	+71.4K	+.7%	+.7%
No Offload	+704.3K	+541.8K	+162.5K	+1.3%	+1.4%
1 in 12 to remain DBI	+363.4K	+282.2K	+81.2K	+1.3%	+1.3%
3 in 6 to qualify DBI for allowance items	-118.0K	-98.6K	-19.4K	-.3%	-.5%
\$50 ERL	+48.8K	+47.6K	+1.2K	+.6%	+.6%
\$100 ERL	+96.7K	+93.0K	+3.7K	+1.1%	+.9%
Combination A	-176.2K	-113.5K	-62.8K	-.3%	-.3%
Combination B	-52.5K	-34.9K	-17.6K	+.5%	+.6%
Combination C	+183.5K	+136.5K	+47.0K	+.7%	+.7%
Combination D	+210.0K	+159.1K	+50.9K	+.4%	+.5%
Combination E	-85.9K	-67.0K	-18.9K	+.2%	+.2%
Combination F	-32.3K	-10.8K	-43.1K	+.8%	+1.0%
Combination G	-417.4K	-285.8K	-131.6K	+.5%	+1.1%
Combination A with OLMF = 5	-299.4K	-227.4K	-72.0K	-.6%	-1.2%
Combination A with SLF = 1	-662.7K	-457.6K	-205.1K	-3.1%	-3.3%

¹Combination policies are defined in TABLE XI, page 37.

TABLE II
ADDITIONAL STATISTICS FOR USS ORION

ALTERNATIVES ¹	\$OH + DI			NET REQN EFF	NET UNIT EFF
	TOTAL	NSA	APA		
Benchmark	3,993.2K	2,271.5K	1,721.6K	92.2%	79.3%
30 Day Offload	-44.5K	-43.2K	-1.3K	-6%	-4%
360 Day Offload	+159.0K	+156.8K	+2.2K	+1.0%	+1.1%
No Offload	+354.6K	+345.5K	+9.0K	+2.6%	+3.3%
1 in 12 to remain DBI	+205.6K	+203.4K	+2.2%	+2.5%	+2.3%
3 in 6 to qualify DBI for allowance items	-31.1K	-31.1K	OK	-2%	-7%
\$50 ERL	+39.2K	+39.1K	OK	+1.3%	+1.4%
\$100 ERL	+72.3K	+72.1K	+2K	+1.9%	+2.0%
Combination A	-8.3K	-7.0K	-1.3K	+1.5%	+1.0%
Combination B	+25.2K	+25.2K	OK	+1.6%	+1.1%
Combination D	+172.1K	+170.6K	+1.4K	+2.6%	+2.3%
Combination E	-2.2K	-2.2K	OK	+1.0%	+1.5%
Combination F	+35.7K	+36.7K	-1.1K	+1.7%	+1.9%
Combination G	-205.5K	-157.6K	-47.9K	+2.1%	+2.1%
Combination A with OLMF = 5	-73.1K	-71.7K	-1.4K	+7%	-1.0%
Combination A with SLF = 1	-190.7K	-144.8K	-45.9K	-1%	-1.1%

¹Combination policies are defined in TABLE XI, page 37.

DOCUMENT CONTROL DATA - R & D

Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) Navy Fleet Material Support Office Management Department (92) Mechanicsburg, PA 17055		2a. REPORT SECURITY CLASSIFICATION Unclassified	
		2b. GROUP	
3. REPORT TITLE Unauthorized Long Supply Study			
4. DESCRIPTIVE NOTES (Type of report and inclusive dates)			
5. AUTHOR(S) (First name, middle initial, last name) L. J. Burdick			
6. REPORT DATE MAR 28 1979		7a. TOTAL NO. OF PAGES 67	7b. NO. OF REFS 3
8a. CONTRACT OR GRANT NO.		9a. ORIGINATOR'S REPORT NUMBER(S) 137	
b. PROJECT NO. F9241-E22			
c.		9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)	
d.			
10. DISTRIBUTION STATEMENT Distribution of this document is unlimited			
11. SUPPLEMENTARY NOTES		12. SPONSORING MILITARY ACTIVITY	
13. ABSTRACT <p>Tenders are currently required to offload ULS (Unauthorized Long Supply) material at least every 90 days. This study evaluates variations in the timing of offloads, the value of the Economic Retention Level used in computing the ULS quantity and various parameters used in computing an item's authorized inventory levels. Alternative offload policies were evaluated in terms of the impact of (1) dollar investment in on-hand plus due-in stock, (2) number of items offloaded, (3) dollar value of items offloaded, (4) number of resupply orders and Direct Turnover requisitions, (5) gross requisition effectiveness, (6) gross unit effectiveness, and (7) net total cost. Analyses were conducted for an FBM (Fleet Ballistic Missile) submarine tender and an attack submarine tender. The study identified seven alternative policies which reduced the number of current offloads by over 50% with no decrease in effectiveness and less than 2% growth in inventory dollar value. The most significant factor in these seven alternatives was an adjustment in the Economic Retention Level from the current value of \$10 or \$100.</p>			

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800 North Quincy Street
Arlington, VA 22217

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Operations Research and
Economic Analysis Office
(DLA-LO)
Cameron Station
Alexandria, VA 22314

Mr. Bernard B. Rosenman
U. S. Army Inventory Research Office
Room 800, Custom House
2nd and Chestnut Sts
Philadelphia, PA 19106

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Department of the Air Force
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Gunter Air Force Station
Gunter, ALA 36114